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Geomechanical Risk Assessment for Subsurface Fluid Disposal Operations

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ABSTRACT

Numerical models are commonly used to estimate the state of stress in the subsurface for various engineering applications. These estimates are subject to considerable uncertainty, and yet, the estimates are almost always deterministic, yielding no information about the certainty of the prediction. For some applications, unquantified uncertainties in stress are often acceptable, because the risks related to geomechanics may be of low relative importance compared to other risks (e.g. recoverable resource volume), for which uncertainties are often quantified. Furthermore, many geomechanics-related risks in the petroleum industry are relatively short lived (e.g. well bore stability), and decrease in importance with time. In contrast, for waste water injection or geologic carbon sequestration (GCS), geomechanics-related risks (e.g. seal integrity, induced seismicity) are on par with resource-related risks and are of long-term concern, with the risk generally increasing in importance for a significant period of time. For these reasons, the deterministic stress estimation and risk analysis approaches generally applied in the petroleum industry are insufficient for GCS applications. This paper describes a Bayesian approach to geomechanical uncertainty quantification and risk assessment. The method is demonstrated using data from an active enhanced oil recovery/geologic carbon sequestration field as a case study.